

APPENDIX G

**RESULTS AND CHAIN-OF-CUSTODY FORMS FOR SUBSTRATE
UTILIZATION STUDY
AND THEORETICAL ACETATE
REQUIREMENT CALCULATIONS**

THEORETICAL ACETATE REQUIREMENT CALCULATIONS

Equations for reactions of acetate ($\text{C}_2\text{H}_3\text{O}_2^-$) with competing electron acceptors oxygen (O_2), nitrate (NO_3^-) and ClO_4^- are as follows [Coates, J. D. et. al. 2000. The diverse microbiology of (per)chlorate reduction. pp 257-270 *In*: E.T. Urbansky (ed.) Perchlorate in the Environment. *Environmental Science Research*, Vol. 57. Kluwer Academic/Plenum: New York]:

- 1) $\text{CH}_3\text{COO}^- + \text{ClO}_4^- \rightarrow 2 \text{HCO}_3^- + \text{H}^+ + \text{Cl}^-$
- 2) $5 \text{CH}_3\text{COO}^- + 8 \text{NO}_3^- + 3 \text{H}^+ \rightarrow 10 \text{HCO}_3^- + 4 \text{H}_2\text{O} + 4 \text{N}_2$
- 3) $\text{CH}_3\text{COO}^- + 2 \text{O}_2 \rightarrow 2 \text{HCO}_3^- + \text{H}^+$

Based on influent [ClO_4^-] of 10 mg/L, influent [NO_3^-] of 50 mg/L, and influent [O_2] of 8 mg/L, acetate (abbreviated Ac^- here) requirements are as follows:

- 1) $10 \text{ mg/L } \text{ClO}_4^-/\text{L} \times 1 \text{ mmol } \text{Ac}^-/1 \text{ mmol } \text{ClO}_4^- \times 59 \text{ mg } \text{Ac}^-/\text{mmol } \text{Ac}^- \times 1 \text{ mmol } \text{ClO}_4^-/99.5 \text{ mg } \text{ClO}_4^- = \underline{5.9 \text{ mg } \text{Ac}^-/\text{L}}$

Where 59 mg and 99.5 mg are the molecular weights of 1 mmol of acetate and ClO_4^- , respectively.

- 2) $50 \text{ mg } \text{NO}_3^-/\text{L} \times 1 \text{ mmol } \text{NO}_3^-/62 \text{ mg } \text{NO}_3^- \times 5 \text{ mmol } \text{Ac}^-/8 \text{ mmol } \text{NO}_3^- \times 59 \text{ mg } \text{Ac}^-/1 \text{ mmol } \text{Ac}^- = \underline{29.7 \text{ mg } \text{Ac}^-/\text{L}}$

Where 62 mg is the molecular weight of 1 mmol of NO_3^- .

- 3) $8 \text{ mg } \text{O}_2/\text{L} \times 1 \text{ mmol } \text{O}_2/32 \text{ mg } \text{O}_2 \times 1 \text{ mmol } \text{Ac}^-/2 \text{ mmol } \text{O}_2 \times 59 \text{ mg } \text{Ac}^-/1 \text{ mmol } \text{Ac}^- = \underline{7.4 \text{ mg } \text{Ac}^-/\text{L}}$

Where 32 mg is the molecular weight of 1 mmol of O_2 .

The total theoretical Ac^- requirement based on the above-listed concentrations of electron acceptors is thus $5.9 \text{ mg/L} + 29.3 \text{ mg/L} + 7.4 \text{ mg/L} = \underline{42.6 \text{ mg/L}}$.

EPA 8015B - Methanol

Client: Center for Env. Microbiology
 Project: Acenol Study
 Job No.: 22108
 Matrix: Water
 Analyst: TPW

Date Sampled: 04/03/03
 Date Received: 04/04/03
 Date Analyzed: 04/07/03
 Batch Number: GC28015W0226

Sample ID	Detection Limit mg/L	Methanol mg/L
Method Blank	1.0	ND
7-1-0	1.0	ND
7-2-0	1.0	ND
8-1-0	1.0	28
8-2-0	1.0	30
9-1-0	1.0	59
9-2-0	1.0	61
10-1-0	1.0	110
10-2-0	1.0	77
11-1-0	1.0	160
11-2-0	1.0	140
12-1-0	1.0	200
12-2-0	1.0	140
7-1-24	1.0	ND
7-2-24	1.0	ND
8-1-24	1.0	26
8-2-24	1.0	29



EPA 8015B - Methanol

Client: Center for Env. Microbiology
Project: Acenol Study
Job No.: 22108
Matrix: Water
Analyst: TPW

Date Sampled: 04/03/03
Date Received: 04/04/03
Date Analyzed: 04/07/03
Batch Number: GC28015W0227

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Methanol by EPA 8015B

Client: Center for Env. Microbiology
 Project: Acenol Study
 Job No.: 22307
 Matrix: Water
 Analyst: TPW

Date Sampled: 04/03/03
 Date Received: 05/12/03
 Date Analyzed: 05/12-15/03
 Batch Number: GC28015W0236
 GC28015W0237
 GC28015W0238
 GC28015W0239

Sample ID	Reporting Limit mg/L	Methanol mg/L
Method Blank	1.0	ND
7-1-4	1.0	ND
7-2-4	1.0	ND
8-1-4	1.0	26
8-2-4	1.0	28
9-1-4	1.0	46
9-2-4	1.0	55
10-1-4	1.0	120
10-2-4	1.0	98
11-1-4	1.0	150
11-2-4	1.0	110
12-1-4	1.0	210
12-2-4	1.0	180
7-1-8	1.0	ND
7-2-8	1.0	ND
8-1-8	1.0	26
8-2-8	1.0	13
9-1-8	1.0	45
9-2-8	1.0	50
10-1-8	1.0	110
10-2-8	1.0	87

Methanol by EPA 8015B

Client: Center for Env. Microbiology
 Project: Acenol Study
 Job No.: 22307
 Matrix: Water
 Analyst: TPW

Date Sampled: 04/03/03
 Date Received: 05/12/03
 Date Analyzed: 05/12-15/03
 Batch Number: GC28015W0236
 GC28015W0237
 GC28015W0238
 GC28015W0239

Sample ID	Reporting Limit mg/L	Methanol mg/L
Method Blank	1.0	ND
11-1-8	1.0	140
11-2-8	1.0	150
12-1-8	1.0	220
12-2-8	1.0	150
7-1-12	1.0	ND
7-2-12	1.0	ND
8-1-12	1.0	25
8-2-12	1.0	24
9-1-12	1.0	51
9-2-12	1.0	36
10-1-12	1.0	77
10-2-12	1.0	100
11-1-12	1.0	96
11-2-12	1.0	150
12-1-12	1.0	200
12-2-12	1.0	210
7-1-16	1.0	ND
7-2-16	1.0	ND
8-1-16	1.0	22
8-2-16	1.0	22

Methanol by EPA 8015B

Client: Center for Env. Microbiology
Project: Acenol Study
Job No.: 22307
Matrix: Water
Analyst: TPW

Date Sampled: 04/03/03
Date Received: 05/12/03
Date Analyzed: 05/12-15/03
Batch Number: GC28015W0236
GC28015W0237
GC28015W0238
GC28015W0239

Sample ID	Reporting Limit mg/L	Methanol mg/L
Method Blank	1.0	ND
9-1-16	1.0	52
9-2-16	1.0	37
10-1-16	1.0	75
10-2-16	1.0	60
11-1-16	1.0	96
11-2-16	1.0	120
12-1-16	1.0	160
12-2-16	1.0	180
7-1-20	1.0	ND
7-2-20	1.0	ND
8-1-20	1.0	19
8-2-20	1.0	28
9-1-20	1.0	53
9-2-20	1.0	41
10-1-20	1.0	98
10-2-20	1.0	110
11-1-20	1.0	140
11-2-20	1.0	120
12-1-20	1.0	130
12-2-20	1.0	170



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Project Manager: <u>[Signature]</u>		Phone: _____ Fax: _____		Address: (Report and Billing)		Remarks/Special Instructions	
Client Name: (Report and Billing)		Address: (Report and Billing)		Address: (Report and Billing)		Requested due date: _____	
Centrum ID (Lab use only)	Sample ID (As it should appear on report)	Date sampled	Time sampled	Sample matrix	Site location	Containers: # and type	Turn-Around Time
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11K-201-03	11K-201-03	11-1-04	11:00	Soil	Site 1	100g	
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1	1-1-4	4-3		M		
2	1-2-4	4-3				
3	1-1-4	4-3				
4	1-2-4	4-3				
5	1-1-4	4-3				
6	1-2-4	4-3				
7	1-1-4	4-3				
8	1-2-4	4-3				
9	1-1-4	4-3				
10	1-2-4	4-3				
11	1-1-4	4-3				
12	1-2-4	4-3				
1) Relinquished by: (Sampler's Signature) <u>Ken</u> Date: _____ Time: _____						
2) Received by: _____ Date: _____ Time: _____						
The delivery of samples and the signature on this chain of custody form constitutes authorization to perform the analyses specified above under the Terms and Conditions set forth on the back hereof.						
Laboratory Notes:						
To be completed by Laboratory personnel: Samples chilled? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> From Field Custody seals? <input type="checkbox"/> Yes <input type="checkbox"/> No All sample containers intact? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Courier <input type="checkbox"/> UPS/Fed Ex <input type="checkbox"/> Hand carried						
Date: _____ Time: _____						
Date: _____ Time: _____						
Date: _____ Time: _____						
Date: _____ Time: _____						
Sample Disposal <input type="checkbox"/> Client will pick up <input type="checkbox"/> Return to client <input type="checkbox"/> Lab disposal						
Sample Locator No.						
Turn-Around Time <input type="checkbox"/> 24 Hr. RUSH* <input type="checkbox"/> 48 Hr. RUSH* <input type="checkbox"/> Normal TAT *Requires PRIOR approval, additional charges apply Requested due date: _____						
Remarks/Special Instructions						
8015M: Diesel, Fuel Screen, Carbon Chain						
8015M: Gas only						
8021B: BTEX/MBE Only						
418.1 (TRPH), 413.2, 1664						
GC or GCMS Volatiles by 5035*						
GCMS: 8260B, 8021B, 624, 524.2						
GCMS: MBE Conf. Only BTEX/Oxygenates Only						
GCMS: 8270C, 625						
8080: Pesticides, PCBs, Pest/PCB						
Metals: Title 22 (CAM), RCRA, PP						
PH, TDS, TSS, Conductivity						
Flashpoint, Hex Cr						



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Project No:		Project Name:		Project Manager:		Address:		Site location		Containers:		Please Circle Analyses Requested		Turn-Around Time					
Project Name:		Project Manager:		Address:		Site location		Containers:		Containers:		Please Circle Analyses Requested		Turn-Around Time					
Project Name:		Project Manager:		Address:		Site location		Containers:		Containers:		Please Circle Analyses Requested		Turn-Around Time					
Project Name:		Project Manager:		Address:		Site location		Containers:		Containers:		Please Circle Analyses Requested		Turn-Around Time					
Centrum ID (Lab use only)	Sample ID (As it should appear on report)	Date sampled	Time sampled	Sample matrix	Site location	Containers: # and type	8015M: Diesel, Fuel Screen, Carbon Chain	8015M: Gas only	8021B: BTEX/MIBE Only	418.1 (TRPH), 413.2, 1664	GC or GCMS Volatiles by 5035*	GCMS: 8260B, 8021B, 624, 524.2	GCMS: MIBE Conf. Only, BTEX/Oxygens Only	GCMS: 8270C, 625	8080: Pesticides, PCBs, PAH/PCB	Metals: Title 22 (CAM), RCRA, PP	pH, TDS, TSS, Conductivity	Flashpoint, Hex Cr	Turn-Around Time
11	12-1-44	4/2		W															<input type="checkbox"/> 24 Hr. RUSH* <input type="checkbox"/> 48 Hr. RUSH* <input checked="" type="checkbox"/> Normal TAT
12	12-2-44																		*Requires PRIOR approval, additional charges apply
13	4-1-8																		Requested due date:
14	4-2-8																		Remarks/Special Instructions
15	4-3-8																		
16	4-4-8																		
17	4-5-8																		
18	4-6-8																		
19	4-7-8																		
20	4-8-8																		
21	4-9-8																		
22	4-10-8																		
23	4-11-8																		
24	4-12-8																		
25	4-13-8																		
26	4-14-8																		
27	4-15-8																		
28	4-16-8																		
29	4-17-8																		
30	4-18-8																		
31	4-19-8																		
32	4-20-8																		
33	4-21-8																		
34	4-22-8																		
35	4-23-8																		
36	4-24-8																		
37	4-25-8																		
38	4-26-8																		
39	4-27-8																		
40	4-28-8																		
41	4-29-8																		
42	4-30-8																		
43	4-31-8																		
44	4-32-8																		
45	4-33-8																		
46	4-34-8																		
47	4-35-8																		
48	4-36-8																		
49	4-37-8																		
50	4-38-8																		
51	4-39-8																		
52	4-40-8																		
53	4-41-8																		
54	4-42-8																		
55	4-43-8																		
56	4-44-8																		
57	4-45-8																		
58	4-46-8																		
59	4-47-8																		
60	4-48-8																		
61	4-49-8																		
62	4-50-8																		
63	4-51-8																		
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65	4-53-8																		
66	4-54-8																		
67	4-55-8																		
68	4-56-8																		
69	4-57-8																		
70	4-58-8																		
71	4-59-8																		
72	4-60-8																		
73	4-61-8																		
74	4-62-8																		
75	4-63-8																		
76	4-64-8																		
77	4-65-8																		
78	4-66-8																		
79	4-67-8																		
80	4-68-8																		
81	4-69-8																		
82	4-70-8																		
83	4-71-8																		
84	4-72-8																		
85	4-73-8																		
86	4-74-8																		
87	4-75-8																		
88	4-76-8																		
89	4-77-8																		
90	4-78-8																		
91	4-79-8																		
92	4-80-8																		
93	4-81-8																		
94	4-82-8																		
95	4-83-8																		
96	4-84-8																		
97	4-85-8																		
98	4-86-8																		
99	4-87-8																		
100	4-88-8																		
101	4-89-8																		
102	4-90-8																		
103	4-91-8																		
104	4-92-8																		
105	4-93-8																		
106	4-94-8																		
107	4-95-8																		
108	4-96-8																		
109	4-97-8																		
110	4-98-8																		
111	4-99-8																		
112	4-100-8																		
113	4-101-8																		
114	4-102-8																		
115	4-103-8																		
116	4-104-8																		
117	4-105-8																		
118	4-106-8																		
119	4-107-8																		
120	4-108-8																		
121	4-109-8																		
122	4-110-8																		
123	4-111-8																		
124	4-112-8																		
125	4-113-8																		
126	4-114-8																		
127	4-115-8																		
128	4-116-8																		
129	4-117-8																		



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Project No:		Project Name:		Please Circle Analyses Requested										
Project Manager:		Phone:		Fax:										
Client Name:		Address:		<div style="display: flex; justify-content: space-between;"> <div> 8015M: Diesel, Fuel Screen, Carbon Chain 8015M: Gas only 8021B: BTEX/MIBE Only 418.1 (TRPH), 413.2, 1664 GC or GCMS Volatiles by 5035* GCMS: 8260B, 8021B, 624, 524.2 GCMS: MIBE Conf. Only, BTEX/Oxygenates Only GCMS: 8270C, 625 8080: Pesticides, PCBs, Pest/PCB Metals: Title 22 (CAM), RCRA, PP pH, TDS, TSS, Conductivity Flashpoint, Hex Cr </div> <div> Turn-Around Time <input type="checkbox"/> 24 Hr. RUSH* <input type="checkbox"/> 48 Hr. RUSH* <input checked="" type="checkbox"/> Normal TAT *Requires PRIOR approval, additional charges apply Requested due date: _____ Remarks/Special Instructions </div> </div>										
Centrum ID (Lab use only)	Sample ID (As it should appear on report)	Date sampled	Time sampled	Sample matrix	Site location	Containers: # and type								
1	11-1-12	4/3		W										
2	11-2-12													
3	12-1-12													
4	12-2-12													
5	1-1-12													
6	7-2-12													
7	8-1-12													
8	7-2-12													
9	7-1-12													
10	7-8-12													
1) Relinquished by: (Sampler's Signature)		Date:	Time:	3) Relinquished by:		Date:	Time:	To be completed by Laboratory personnel:						
2) Received by:		Date:	Time:	4) Received by:		Date:	Time:	Samples chilled? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> From Field Custody seals? <input type="checkbox"/> Yes <input type="checkbox"/> No All sample containers intact? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Courier <input type="checkbox"/> UPS/Fed Ex <input type="checkbox"/> Hand carried						
The delivery of samples and the signature on this chain of custody form constitutes authorization to perform the analyses specified above under the Terms and Conditions set forth on the back hereof.								Sample Disposal <input type="checkbox"/> Client will pick up <input type="checkbox"/> Return to client <input type="checkbox"/> Lab disposal						
Laboratory Notes:								Sample Locator No.						



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Project No:		Project Name:		Project Manager:		Client Name:		Address:		Site location		Containers:		Date sampled		Time sampled		Sample matrix		8015M: Diesel, Fuel Screen, Carbon Chain		8021B: BTEX/MIBE Only		418.1 (TRPH), 413.2, 1664		GC or GCMS Volatiles by 5035*		GCMS: 8260B, 8021B, 624, 524.2		GCMS: MIBE Conf. Only, BTEX/Oxygens Only		GCMS: 8270C, 625		8080: Pesticides, PCBs, PAH/PCB		Metals: Title 22 (CAM), RCRA, PP		pH, TDS, TSS, Conductivity		Flashpoint, Hex Cr			
1) Relinquished by: (Sampler's Signature)		Date:		Time:		3) Relinquished by:		Date:		Time:		To be completed by Laboratory personnel:		Samples chilled? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> From Field		Custody seals? <input type="checkbox"/> Yes <input type="checkbox"/> No		All sample containers intact? <input type="checkbox"/> Yes <input type="checkbox"/> No		<input type="checkbox"/> Courier <input type="checkbox"/> UPS/Fed Ex <input type="checkbox"/> Hand carried		Sample Disposal		<input type="checkbox"/> Client will pick up		<input type="checkbox"/> Return to client		<input type="checkbox"/> Lab disposal		Turn-Around Time		<input type="checkbox"/> 24 Hr. RUSH*		<input type="checkbox"/> 48 Hr. RUSH*		<input type="checkbox"/> Normal TAT		*Requires PRIOR approval, additional charges apply		Requested due date:		Remarks/Special Instructions	
2) Received by:		Date:		Time:		4) Received by:		Date:		Time:		5) Relinquished by:		Date:		Time:		6) Received for Laboratory by:		Date:		Time:		Sample Locator No.																			

The delivery of samples and the signature on this chain of custody form constitutes authorization to perform the analyses specified above under the Terms and Conditions set forth on the back hereof.

Laboratory Notes:



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Project No:		Project Name:		Project Manager:		Address:		Phone:		Fax:			
Centrum ID (Lab use only)		Sample ID (As it should appear on report)		Date sampled		Time sampled		Sample matrix		Site location		Containers: # and type	
1	11-1-16	4/12											
2	11-2-16	4/12											
3	11-3-16	4/12											
4	11-4-16	4/12											
5	11-5-16	4/12											
6	11-6-16	4/12											
7	11-7-16	4/12											
8	11-8-16	4/12											
9	11-9-16	4/12											
10	11-10-16	4/12											
11	11-11-16	4/12											
12	11-12-16	4/12											
13	11-13-16	4/12											
14	11-14-16	4/12											
15	11-15-16	4/12											
16	11-16-16	4/12											
17	11-17-16	4/12											
18	11-18-16	4/12											
19	11-19-16	4/12											
20	11-20-16	4/12											
21	11-21-16	4/12											
22	11-22-16	4/12											
23	11-23-16	4/12											
24	11-24-16	4/12											
25	11-25-16	4/12											
26	11-26-16	4/12											
27	11-27-16	4/12											
28	11-28-16	4/12											
29	11-29-16	4/12											
30	11-30-16	4/12											
1) Relinquished by: (Sampler's Signature) Date: Time: 3) Relinquished by: Date: Time:													
2) Received by: Date: Time: 4) Received by: Date: Time:													
5) Relinquished by: Date: Time:													
6) Received for Laboratory by: Date: Time:													
The delivery of samples and the signature on this chain of custody form constitutes authorization to perform the analyses specified above under the Terms and Conditions set forth on the back hereof.													
Laboratory Notes:													
Project Name: ACME STUDY													
Project Manager: J. Lee													
Address: (Report and Billing)													
Phone: Fax:													
8015M: Diesel, Fuel Screen, Carbon Chain													
8015M: Gas only													
8021B: BTEX/MIBE Only													
418.1 (TRPH), 413.2, 1664													
GC or GCMS Volatiles by 5035													
GCMS: 8260B, 8021B, 624, 524.2													
GCMS: MIBE Conf. Only, BTEX/Oxygens Only													
GCMS: 8270C, 625													
8080: Pesticides, PCBs, Post/PCB													
Metals: Title 22 (CAM), RCRA, PP													
pH, TDS, TSS, Conductivity													
Flashpoint, Hex Cr													
Turn-Around Time													
<input type="checkbox"/> 24 Hr. RUSH*													
<input type="checkbox"/> 48 Hr. RUSH*													
<input checked="" type="checkbox"/> Normal TAT													
*Requires PRIOR approval, additional charges apply													
Requested due date:													
Remarks/Special Instructions													



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Please Circle Analyses Requested															
Project No:	Project Name:	Phone:	Fax:	Turn-Around Time											
Project Manager:	Address:	To be completed by Laboratory personnel:			Sample Disposal										
Client Name:	Address:	Samples chilled? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> From Field			<input type="checkbox"/> Client will pick up										
Centrum ID	Sample ID	Date sampled	Time sampled	Sample matrix	Site location	Containers: # and type	Custody seals? <input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Return to client					
(Lab use only)	(As it should appear on report)						All sample containers intact? <input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Lab disposal					
							<input type="checkbox"/> Courier <input type="checkbox"/> UPS/Fed Ex <input type="checkbox"/> Hand carried			Sample Locator No.					
1) Relinquished by: (Sampler's Signature)	Date:	Time:	3) Relinquished by:			Date:	Time:	To be completed by Laboratory personnel:			Sample Disposal				
2) Received by:	Date:	Time:	4) Received by:			Date:	Time:	Samples chilled? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> From Field			<input type="checkbox"/> Client will pick up				
			5) Relinquished by:			Date:	Time:	Custody seals? <input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Return to client				
			6) Received for Laboratory by:			Date:	Time:	All sample containers intact? <input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Lab disposal				
						Date:	Time:	<input type="checkbox"/> Courier <input type="checkbox"/> UPS/Fed Ex <input type="checkbox"/> Hand carried							
The delivery of samples and the signature on this chain of custody form constitutes authorization to perform the analyses specified above under the Terms and Conditions set forth on the back hereof.										Laboratory Notes:					